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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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GURTEJ S. SANDHU

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04/08/2003

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EXAMINER

PHAM, THANHHA S

ART UNIT

PAPER NUMBER

2813

DATE MAILED: 04/08/2003

27

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/233,377

Applicant(s)

SANDHU ET AL.

Examiner

Thanhha Pham

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 August 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 24,45 and 52-78 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 45 and 55-61 is/are allowed.
- 6) ☒ Claim(s) 62-69 and 71-78 is/are rejected.
- 7) ☒ Claim(s) 53 and 54 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 26.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

This Office Action responds to Applicant's Amendment in Paper No. 24 dated 8/30/02.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

1. **Claims 74-78 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.**

The specification page 9 lines 3-8 and page 12 lines 22-23 enables for those skilled in the art to: (1) utilize a compressive stress inducing layer for transforming the first crystalline phase of silicide to the second crystalline phase of silicide at temperature of less than or equal to 750°C in an inert atmosphere with less stringent time requirement; and (2) annealing 600°C, 760 torrs in inert gas for 20 seconds to form the silicide of first crystalline phase. The specification page 9 lines 3-8 and page 12 lines 22-23 does not enable for those skill in the art to practice the claimed invention with limitation of "after forming the refractory metal silicide comprising a first crystalline phase, annealing the compressive stress inducing material layer and the refractory

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metal silicide comprising the first crystalline line phase to form a refractory metal silicide of a second crystalline phase wherein forming the compressive stress inducing material layer is configured to permit the annealing to convert the first crystalline phase to the second crystalline phase via a 20 second anneal in an inert atmosphere at a temperature of about 600°C" in claims 74 and 75. The specification page 9 lines 3-8 and page 12 lines 22-23 also does not enable for those skilled in the art to practice the claimed invention with limitation of "subsequently annealing the refractory metal silicide comprising the first crystalline phase to a second crystalline phase, wherein the compressive stress inducing atoms and the compressive stress inducing material layer are configured to cooperate to permit the annealing to convert the first crystalline phase to the second crystalline phase via a 20 second anneal in an inert atmosphere at a temperature of about 600°C" as in claim 77.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 71-76 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

- With respect to claim 71,

lines 8-9, "the refractory metal comprising a first crystalline phase" lacking antecedent basis should be changed to "the refractory metal silicide comprising the first crystalline phase"

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- With respect to claim 75,
line 7, "annealing the refractory metal comprising a first crystalline phase",
lacking antecedent basis, should be changed to "annealing the refractory metal silicide
comprising the first crystalline phase"

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(e) the invention was described in-

(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or

(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

- 3. Claims 62-66, 68-70, 74-78 are rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Apte et al [US 5,593,924].**

Apte et al, figs 1-6 and col 1-4, discloses the claimed method of forming a refractory metal silicide layer comprising steps of:

forming a titanium silicide (32, fig. 3) over a first side of a substrate, the titanium silicide comprising a first crystalline phase C49;

providing compressive stress inducing atoms Ge into the titanium silicide comprising the first crystalline phase C49 (col. 3 lines 49-56);

forming a compressive stress inducing material layer (36, silicon nitride, fig. 5, col 3 lines 57-67) over the titanium silicide layer comprising the first crystalline phase C49; and

subsequently annealing the titanium silicide comprising the first crystalline phase to convert the first crystalline phase C49 to a second crystalline phase C54

With respect to claim 64, the titanium silicide layer comprising the first crystalline phase C49 would have a first temperature coefficient of expansion wherein the compressive stress inducing material comprising silicon nitride having a second temperature coefficient of expansion that is less than the first temperature coefficient of expansion.

The claiming of a new use, new function or unknown property which is inherently present in prior art does not necessarily make the claim patentable. See *In re Best*, 562 F 2d 1252, 1254, 195 USPQ 430, 433 (CCPA 1977).

4. Claims 24 and 52 are rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Cabral et al [US 5,828,131].

Cabral et al, fig 1-16 col 1-12, discloses the claimed method of forming a refractory metal silicide comprising steps:

forming a titanium metal layer over a silicon containing substrate and providing compressive stress inducing atoms into the titanium layer , the compressive stress

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inducing atoms being larger than silicon atoms (e.g. refractory metal W in Ti-alloy, col 11 lines 48-52 and col 10 lines 15-18);

after the providing, first annealing the titanium metal layer containing the compressive stress inducing atoms to form a titanium silicide layer substantially of a first crystalline phase (C49);

second annealing the titanium silicide layer of the first crystalline phase under conditions effective to transform said titanium silicide layer to a more dense layer substantially of a second crystalline phase (C59).

[see col 11 lines 48-67 and col 12 lines 1-49 for details]

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claim 67 is rejected under 35 U.S.C. 103(a) as being unpatentable over Apte et al [US 5,593,924] in view of Kawamura et al [JP 8139056].

Apte et al, figs 1-6 and col 1-4, discloses a method of forming a refractory metal silicide layer comprising steps of:

forming a titanium silicide layer (32, C49, fig 3) over a first side of a substrate (10), the titanium silicide layer comprising a first crystalline phase;

disposing introducing stress inducing atoms Ge into the titanium silicide layer (col. 3 lines 49-56); and

subsequently annealing the titanium silicide comprising the first crystalline phase to convert the first crystalline phase (C49) to a second crystalline phase (C54).

Apte et al does not teach disposing stress inducing material layer operationally coupled to the titanium silicide wherein the disposing stress inducing material layer comprises forming a layer of material configured to induce a compressive stress in the metal silicide on a second side of the substrate wherein the second side is opposed the first side.

However, Kawamura et al teaches disposing stress inducing material layer operationally coupled to the titanium silicide wherein the stress inducing material layer is on the second side of the substrate, wherein the second side is opposed the side of the substrate. By doing so, the phase transformation of the titanium silicide layer from the first crystalline phase (C49) to the second crystalline phase (C54) is promoted in subsequent step of annealing.

Therefore, it would have been obvious for those skilled in the art to combine the teaching of Kawamura et al to dispose the stress inducing material layer on the second side of the substrate wherein the second side is opposed to the first side to perform a better process of forming the titanium silicide layer with the second crystalline phase C54 as reasons give above.

Allowable Subject Matter

6. Claims 45, 55-61 are allowed.
7. Claims 53-54 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.
8. Claims 71-73 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action.
9. The following is an examiner's statement of reasons for allowance: Recorded Prior Art fails to teach a method of forming a refractory metal silicide comprising forming a compressive stress inducing material layer over a first side of a substrate; forming a refractory metal silicide over the compressive stress inducing material layer, the refractory metal silicide comprising a first crystalline phase; and after forming the refractory metal silicide comprising the first crystalline phase, annealing the refractory metal comprising a first crystalline phase to form a refractory metal silicide of a second crystalline phase as characteristics in claim 45. Recorded Prior Art fails to teach a method of forming a refractory metal silicide comprising steps of providing compressive stress inducing atoms comprising germanium into the titanium metal layer; first annealing the titanium metal layer comprising the compressive stress inducing atoms to form a titanium silicide layer substantially comprising a first crystalline phase after providing compressive stress inducing atoms; and second annealing the titanium silicide layer substantially comprising the first crystalline phase under conditions effective to

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transform the titanium silicide layer to a denser layer substantially comprising a second crystalline phase as characteristics in claim 59.

Response to Arguments

10. Applicant's arguments filed 8/30/02 have been fully considered but they are not persuasive.

- With respect to Applicant's argument on page 25 lines 26-27 and pages 26-28, Applicant argues that **(1)** Apte et al (col 3 lines 49-56) does not teach providing compressive stress inducing atoms Ge into titanium silicide comprising the first crystalline phase; and **(2)** Apte et al (col 4 lines 20-23) does not teach forming a compressive stress inducing material layer 36.

Regarding to **(1)**, the same as Applicant's claimed invention, Apte et al (col 3 lines 49-55) teaches implanting Ge into the titanium silicide 32 of the first crystalline phase wherein Ge atoms are provided within to increase driving force of the phase transformation the first crystalline phase C49 to the second crystalline phase C54. Since Apte et al provides the same material of Ge atoms within the titanium silicide comprising first crystalline phase (as in Applicant's claimed invention) for easier transforming the first crystalline phase C49 to the second crystalline phase C54, the step of implanting Ge atoms within the titanium silicide of first crystalline phase of Apte et al can be called as "disposing introducing stress inducing atoms Ge into refractory metal silicide" as being claimed (claims 62-66, 68-70, 77-78).

Regarding to (2), the same as Applicant's claimed invention, Apte et al forming silicon nitride (layer 36) over the titanium silicide 32 of the first crystalline phase for reducing stress and contaminant in the process of transforming the titanium silicide from the first crystalline phase C49 to the second crystalline phase C54. The purpose of using the silicon nitride layer 36 of Apte et al is to increase ability of transforming the first crystalline phase C49 to the second crystalline phase C54. Since Apte et al uses the same material for the same purpose of increasing ability of transforming the first crystalline phase C49 to the second crystalline phase C54, the silicon nitride 36 of Apte et al is the compressive stress inducing material layer of the claimed invention (claims 62-66, 68-70, 77-78).

- With respect to Applicant's argument on pages 29-32, Applicant argues that there is no motivation for combining Kawamara et al to Apte et al. The argument is not persuasive because both of Kawamara et al and Apte et al deal with a process of transforming refractory metal silicide of the first phase. Kawamara et al teaches using the compressive stress inducing material layers (8 or 10) on the second side of the substrate, wherein the refractory metal silicide is formed on the first side of the substrate that is opposed to the first side of the substrate. Kawamara et al does teach advantage of the using of the compressive stress inducing material layers to help the step of transformation the first crystalline phase to the second crystalline phase occurring more effectively (see paragraph [0019]). It would have been obvious for those skilled in the art to combine the teaching of Kawamara et al to the process of Apte et al to have the claimed invention of claim 67 as being rejected above.

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- With respect to Applicant's argument on pages 32-36, Applicant argues that Cabral et al does not disclose providing compressive stress inducing atoms into the titanium metal layer wherein the compressive stress inducing atoms being larger than silicon atoms (e.g. W in Ti-alloy, col 11 lines 48-52 and col 10 lines 15-18". The argument is not persuasive because, the same as Applicant's claimed invention and disclosure, Cabral et al provides W atoms (larger than Si atoms) in the titanium metal layer. The W atoms of Cabral et al is the compressive stress inducing atoms of Applicant's invention because Cabral et al uses W atoms in the titanium metal for sufficient forming the titanium silicide and lowering the temperature of transformation the titanium silicide of first crystalline phase C49 to the titanium silicide of second crystalline C54 (see Cabral et al, col 4 lines 54-67 for details).

Conclusion

11. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

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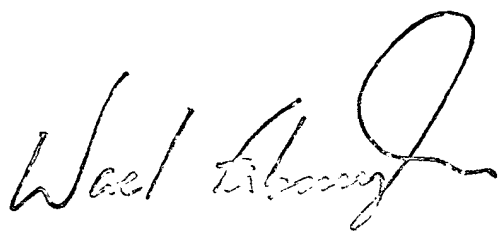
the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanhha Pham whose telephone number is (703) 308-6172. The examiner can normally be reached on Monday-Thursday 8:00 AM - 7:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead can be reached on (703) 308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-3432 for regular communications and (703) 308-7725 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Thanhha Pham
April 6, 2003


SUPERVISOR
TECHNOLOGY CENTER 2800